National Aeronautics and
Space Administration

Office of Biological and Physical Research

MIMICKING THE BIRTH AND GROWTH OF PLANETS AND RINGS

PHYSICAL SCIENCES RESEARCH
BIOASTRONAUTICS RESEARCH
FUNDAMENTAL SPACE BIOLOGY
SPACE PRODUCT DEVELOPMENT

Why is it important?

Understanding the release of dust and the rebound of colliding particles is crucial to understanding the evolution of planetary rings and the origins of the planets themselves. Collisions between the small particles in planetary rings occur at very low speeds, often less than 2 feet per minute (1 cm/s). Similar collisions occur in the early stages of planet formation, when the colliding rock and ice particles are so small that there is very little gravitational pull between them. As a result, even slow collisions can result in material being ejected or the particles bouncing apart instead of sticking together.

What is NASA doing?

To study the question of low-speed dust collisions, NASA sponsored the COLLisions Into Dust Experiment (COLLIDE) at the University of Colorado. It was designed to spring-launch marble-sized projectiles into trays of powder similar to space or lunar dust. COLLIDE-1 (1998) discovered that collisions below a certain energy threshold eject no material. COLLIDE-2 was designed to identify where the threshold is.

The COLLIDE apparatus—largely developed and built by graduate students at Colorado—carries six Impactor Box Systems. Each launches a pellet at a different speed into a small tray of dust. All six systems worked well. The slowest impactor ejected no material and stuck in the target. The faster impactors produced ejecta; some rebounded, while others stuck in the target.

What are the benefits?

COLLIDE investigations support work in several areas, including the following:

- providing a broader context for interpreting ground-based research into planet formation and growth;
- producing a video record of unique impacts in microgravity for education purposes;
- providing graduate students, who did much of the engineering work, with valuable flight experience; and
- developing applications for space flight and experimentation.

What is next?

The data from COLLIDE-2 are being analyzed, and options for a third flight are being studied. A ground-based investigation, PRIME, is flying on the KC-135 low-g aircraft for tests that can be run in less than 20 seconds of low-g.

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Clues to the formation of planets and planetary rings—like Saturn's dazzling ring system (above—may be found by studying how dust grains interact as they collide at low speeds. In COLLIDE-2, scientists nudged small projectiles into dust beds and recorded how the dust splashed outward (below). As depicted in the drawing, the projectile came from the top of the video frame.